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EDITORIAL

We make no excuse in drawing our readers' attention to the article published in this issue by N. J. Scorgie and C. W. Ottaway. It deals with certain anatomical features of the bovine vulvo-vaginal tract. Anatomy is the basis of medical or surgical science, and no one can expect to become expert in any particular branch of the Veterinary art without a sound knowledge of the structures with which he has to deal. For many years we have been obsessed by the so-called " ologies " to such an extent that they have been given an importance which is completely out of balance in our profession. This has led to an unfortunate state of affairs, for outside bodies, and indeed our own profession, have sought the advice of pathologists and bacteriologists when they desired authoritative opinions on matters dealing with Veterinary Science. This is a calamity, for it has narrowed the whole conception of the meaning of Veterinary Science. There have been other repercussions following this lead, for pathologists and bacteriologists in sister professions have assumed the right to speak with authority on and even direct the progress of Veterinary education and research. It is time that the profession was awakened to the perils of such a state of affairs and took steps to break down this hold upon its destiny. We have many men in the clinical and other fields who are *au fait* with the requirements of the profession, and to ignore such a wealth of talent is not in the best interests of the profession or of the State.

It is good that two junior members should combine to produce an article which has both an academic and a practical application, and one which should be of great value at the present time.

Veterinary anatomy should be a living, not a dead, subject. Here is evidence that at any rate it has great powers of resurrection, and we look forward to many more evidences of its resuscitation for the benefit of the clinician.

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General Articles

A PLEA FOR BIER'S HYPERÆMIC TREATMENT

By W. M. SCOTT, F.R.C.V.S., D.M.V., F.R.S.(Edin.), *Bridgwater*

Introduction

It was in the early 'nineties that Prof. Bier promulgated a line of treatment which was named after him and which consisted of an artificially-produced hyperæmia. With the passage of years, however, it would appear, both in human and comparative practice, it has grown into disuse, which I venture to think is unfortunate, for in suitable cases it possesses very high curative values.

For over three decades the writer has carried out the treatment in his practice, with, in many cases, excellent results.

With the object of stimulating the interest of those of my colleagues who have not adopted the treatment I append some general observations for their consideration.

Of course it must be understood the treatment has its limitations, for, speaking generally, it can only be applied to the extremities, if one excludes suction by means of the cupping glass. Nevertheless, a large field is to be found where it may be applied, and that, too, successfully.

Mode of Action

The object in view is to bring about a hyperæmic state in a diseased area, and, if this already exists, to aggravate this state. Further, if bacterial invasion has taken place, it stimulates the living tissues in their struggle to thwart this aggression. This is brought about by an increase in the blood volume circulating through the infective foci and bathing the tissues with an increase of bacteriotropic serum *cum* leucocytic elements. It will be seen, therefore, the principle of treatment is closely linked up with that complex system known as *immunology*.

But here a note of warning is necessary. The surgeon when applying the treatment must make sure the *arterial* circulation is not interfered with when a rubber bandage is used; this is done by noting the pulse beat of the artery distal to the constriction. When œdema obliterates the pulse beat one must be guided by the attitude of the patient. If pain is aggravated, as is shown by the animal pawing, and restlessness, it may be assumed that the bandage is too tight and should be corrected. The five cardinal symptoms of inflammation, as is well known, are: redness—where the skin can show it, heat, swelling, pain, and impaired function; the object of the hyperæmic treatment is to diminish the two latter and increase the three former.

When bacterial infection is in evidence the treatment, too, arrests or mitigates infection. When repair is tardy, be it in hard or soft structures, it activates repair by trophic action.

Mode of Application

Bier adopted three methods in bringing about hyperæmia: (1) elastic constriction; (2) suction by cupping glasses; (3) heated air. As the former is the most applicable in comparative surgery, the writer's remarks shall be confined to this method alone. All that one requires here is an elastic bandage, Martin's for preference, and I have found in emergency cases, when unprepared, one can always find an obsolete inner tube of a cycle which answers the purpose well. If the diseased condition is in the fetlock or foot region the compress should be applied just under the knee joint; if above the knee, below the elbow joint.

The bandage should be wound round several times, one layer overlaying the other, and if a cycle tube is used the two ends are tied with a piece of twine. This completed, the operator should now make sure the arterial circulation is intact distal to the compress, and, if so, the pulse beat can be detected. Failure to find the beat means the bandage is too tight and must be relaxed until the pulse is restored. The length of time the constriction bandage remains must rest upon the judgment of the practitioner, for every case is a law unto itself. Generally speaking, however, in subacute and chronic cases the compress may remain *in situ* six to nine hours per diem. In acute cases, where much pain is in evidence, two to three hours is long enough and repeated after the elapse of five or six hours. As the case progresses, application for a longer period is advised.

Types Suitable for Treatment

When one is dealing with a localised bacterial infection of the extremity, as already stated, hyperæmic treatment is bound up with the complex field of immunology, and, to understand this, one should have a sound knowledge of its *modus operandi.*

By way of illustration, let me cite an infected wound in the coronary band in a horse. The case has been neglected, the animal is in great pain, running a traumatic temperature, breathing quickly, and is unable to bear any weight on the affected limb, which it hot, painful and œdematous.

The pus oozing from the wound, be it noted, is thin, sanious and poor in quality; in short, the antithesis to *"laudable"* pus, clearly showing the immunising index is at zero. Nature is putting up a poor fight and bacterial aggression is on the ascendant. This may be due to a variety of causes:

(1) The infective organisms may be highly virulent, thwarting the activities of the phagocytes—negative chemotaxis.

(2) The general health of the patient may be low, with consequent subnormal bacteriotropic humeral elements of the blood.

(3) The covering, coagulum, over the wound surface acting as a casing preventing the anti-microbic serum with the leucocytes from oozing through.

(4) The bacteria or their toxins may have broken through the local defences invading the lymph or blood stream or both.

Of course, when dealing with a case of this kind the ideal procedure is to

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ascertain the type of bacteria present and administer, in addition, the suitable sera or vaccine, or both. This done, the next step is to increase the blood flow to the focus of infection. This is usually carried out by hot fomentations or antiseptic poultices, which, of course, produces a certain degree of *hyperæmia*. But is it really enough? Certainly it does not compare with the degree produced by Bier's method, for, by strangulating the venous circulation, a large supply of blood is dammed back which in turn freely flushes the area with the patient's serum. The practitioner, however, must not be content to leave the matter here. For example, the wound outlet may be small, in which case it must be enlarged, or the surface of the wound may be indurated or covered with coagula, in which case light curetting is indicated, taking great care not to damage healthy tissue. Or the blood may have a high calcium content, and here decalcifying agents are indicated—systemic and local—and for the former I know of nothing better than sod. cit. While the bandage is applied much good will follow placing the foot in a hot-water bath containing sod. cit. and sod. chlor., which, by their osmotic action, *draw* the blood serum. I prefer this line of treatment to any type of antiseptic, for the former is constructive, while the latter tends to be destructive.

Diseases Amenable to Treatment

Among the many diseases suitable to the treatment of the constricting bandage let me mention some of the most important types the writer met with in past years in practice.

We are all *au fait* with the disastrous results which often follow puncture of the horse's foot by picked-up nails, especially if neglected in the initial stages. Before applying the compress, however, it is imperative for the practitioner to lay open the puncture to its distal end, then place the whole foot in an osmotic bath and apply the bandage. This line of treatment will restore the animal more quickly to normal and reduce the dangerous sequelæ.

Infected wounds in or near the distal end of the limb should receive similar treatment. Recovery from sprained tendons is expedited by the hyperæmic treatment, while the acute pain and lameness in the initial stages of ringbone becomes greatly reduced, and the same remarks apply to sesamoiditis, coronitis, etc. Arthritis, whether traumatic or rheumatic, are also suitable cases for treatment. Injuries to the feet of cattle often hang fire, for here the thinness of the hoof affords little protection to the highly sensitive structures the horn protects, culminating often in disease of the pedal bone. Open joint, if not too advanced and septic infection not too acute, are benefited by the treatment; the discharge, at first increasing, steadily becomes reduced.

Acute and subacute laminitis, too, improve, especially if the hoofs are opened and foot baths applied in conjunction.

In some few cases of incipient navicular disease, if diagnosed, respond favourably also. To those who do not object to being empirically minded the writer would add he has obtained in some instances spectacular results in those cases of obscure lameness whose origin is in those regions below the knee and hock. The treatment is also helpful in canker and quittor.

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These observations, as will be noted, are confined to diseased condition of the limbs. It only remains now for the head and upper part of the neck, where anatomical dispositions lend themselves to Bier's treatment, that needs further comment to conclude the list.

The superficial disposition of the two jugulars, coupled with the deep-seated hard-corded carotids, lends the head and neck to easy passive congestion, by pressure. All that is required is a cord tied round the neck nearest the pectoral region, when the jugulars will be seen to enlarge.

Septic wounds and œdema of the lips, recurrent post-operative actino-bacillosis in the region of the cheek, parotid, submaxilla; irregular strangles abscesses; actinomycosis of the tongue defying orthodox treatment but here the dorsal lingual surface should be deeply scarified first and sod. cit. rubbed in afterwards.

To the inexperienced I should like to interpose here one word of warning. Where there exists œdema of the laryngo-pharyngeal mucosæ, for obvious reasons the hyperæmic treatment is contra-indicated.

Conclusions

Artificially-produced hyperæmia in suitably selected cases is a valuable adjuvant in the therapeutic role, for it is in complete alignment with nature's method of cure; consequently it is based on sound scientific lines. As we know, the first toxic reaction to an irritant culminating in the phenomenon known as inflammation is engorgement of the capillary blood vessels—hyperæmia. Bier's treatment, therefore, is nature's assistant, and if we emulate nature in her healing methods in practice, we reap a rich harvest and cannot go far wrong.

Valuable as this line of treatment is, however, the writer need hardly point out collateral treatment must not be neglected, the line of which is a matter for each practitioner's consideration.

Finally, let me stress once again, in the application of the compress, *venous stasis* and not *arterial strangulation* must ever be the axiom of the operator. Failure in this will only court disaster.

Supplemental to the foregoing remarks and with the view of still further lending support to my plea for the hyperæmic treatment, may I be forgiven if I add a personal note?

Some months ago, while "hopping" over a five-bar gate, I sprained my knee, which gave me considerable pain (aggravated no doubt by the presence of free uric acid) in spite of the application of anodynes and absorbants for two months or so.

I then carried out Bier's treatment for four days and the results were: all the pain had disappeared and I was able for the first time to move my knee about at any angle without the least discomfort.

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TWO ANATOMICAL FEATURES OF CLINICAL IMPORTANCE IN THE VULVO-VAGINAL TRACT OF THE BOVINE

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THE purpose of this note is to draw attention to two anatomical features in the vulvo-vaginal tract of the bovine which are of some importance in the clinical examination of this region. The first of the features referred to does not appear to be described in standard text-books on bovine anatomy, and consists of the presence of a series of annular or circular folds in the wall of the vagina. These folds are normally present in all the vaginæ which we have examined, and under certain conditions may give rise to confusion during visual examination of the vulvo-vaginal tract with the aid of a speculum. The second feature is an abnormal structure which takes the form of a vertical band in the vagina; this we have observed in two heifers only, although it has been reported previously by a number of writers.

In order to simplify later description we are prefacing this note with a short review of the gross anatomy of the visible mucous membrane of the vulvo-vaginal tract and its associated structures. In this we include a few original observations on the dimensions of the ducts associated with the glands of Bartholin and the canals of Gärtner, which were made on 16 dissected specimens.

The Mucous Membrane of the Vagina and its Associated Structures

The correct use of nomenclature is always a problem in anatomical literature, since unfortunately there is no standardised system of terminology to which veterinary anatomical description can conform.

In this note the vulva is taken to be that part of the urogenital tract including and extending from the labia to the external urethral orifice (*meatus urinarius*). The vagina proper extends forwards from the urethral orifice to the neck of the uterus (*os uteri externum*). This terminology is in accordance with the usage in most anatomical literature in the English language. German writers, on the other hand, apply the term vulva to the labia and the immediately adjacent region, whilst the region extending forwards from here to the urethral orifice is termed the vestibule of the vagina. According, therefore, to the terminology of English anatomical works, the vestibule is part of the vulva.

On parting the labia a transverse fold of mucous membrane can be seen immediately anterior to the lower commissure and partially covering the almond-shaped clitoris. Running forwards in the ventral mid-line from this fold to the urethral orifice there is a slight ridge of mucous membrane with a central groove; when a speculum is inserted this groove tends to become obliterated, but it is seen easily by digital examination in the live animal or in a dissected specimen.

Approximately 1¼ inches on each side of the ventral mid-line and 1 inch from the urethral orifice are the openings of the so-called glands of Bartholin (*glandulæ vestibulares majores*). Each opening is covered by a fold of mucous membrane which makes it difficult to locate in the living animal; in the dissected specimen this fold is found with comparative ease, and can be reflected to expose the orifice which in the majority of our specimens was approximately ⅛-inch

in diameter. From each orifice a duct passes backwards and outwards below the mucous membrane for a distance of $\frac{7}{8}$-inch to $1\frac{3}{4}$ inches to join the gland situated in the region of the labia and intimately associated with the fibres of the *constrictor vulvæ* muscle. These glands should not be confused with the *bulbus vestibuli* of the mare which is the homologue of the *corpus cavernosum urethræ* (*corpus spongiosum*) of the male. The function of Bartholin's glands in the cow does not appear to have been determined accurately, but Marshall[1] states that they produce a viscid secretion during sexual excitement. Sometimes retention cysts in Bartholin's glands are met with. They arise as a result of occlusion of the openings of the glands due to inflammatory lesions in the vulva extending to the ducts. Quinlan[2] states that they do not play any part in the causation of sterility, and that surgical interference is not indicated unless there is evidence of enlargement which may cause difficulty in copulation or parturition and retention of secretion in the vagina. According to Hammond[3] cystic Bartholin's glands are frequently found in nymphomaniac cows, although the connection between the cystic condition and nymphomania is problematical.

Apart from the structures described above, the mucous surface of the vulva is free from folds and ridges. One noteworthy feature in this region is the large number of small lymphatic nodules which are scattered under the surface of the epithelium. In granular vaginitis these nodules become considerably enlarged.

At the junction of the vulva and vagina proper there are a number of smooth projections of the mucosa resembling papillæ which vary considerably in number and shape in different animals. They are the *caruncula myrtiformes*, the vestiges of the hymen. Their appearance varies with the age of the animal; in heifers they have the appearance of a well-marked circular fold, best developed in the ventral aspect and may project about $\frac{1}{4}$-inch into the vulvo-vaginal lumen. In old pluriparous cows the *caruncula* are frequently absent but the site is always marked by a slight but definite construction of the wall. Normally no complete hymen exists in the cow, but Williams[4] states that persistent hymen is more common in ruminants than in other species. If it is imperforate it acts as a bar to coitus and also imprisons utero-vaginal secretions, which may become infected with pyogenic organisms. Persistent hymen is believed to be most common in white animals ("white heifer disease") and there would appear to be some justification for considering the condition as a hereditary abnormality.

In the ventral mid-line, immediately posterior to the *caruncula myrtiformes*, is the external urethral orifice (*meatus urinarius*). The opening of the urethra is covered by a horseshoe-shaped fold of mucous membrane which is more prominent anteriorly, and which can often be seen "pulsating" or "winking" when a speculum is *in situ*. Immediately posterior to the urethral orifice lies the suburethral diverticulum, the depth of which varies from 1 to $1\frac{1}{2}$ inches.

On either side of the urethral orifice, and often enclosed in a fold of the *caruncula myrtiformes* may be found the openings of the canals of Gärtner, the vestiges of the Wolffian duct. It is not possible to locate the canals in the living animal but in dissected specimens they are seen, when present, to vary in nature and appearance. When fully developed they may have a diameter of $\frac{1}{4}$-inch and pass forwards for a distance up to 8 inches under the mucosa of the vagina to terminate in the region of the cervix. In some animals they are considerably

smaller in diameter and shorter in length. In still others the canals may be absent on one or both sides, but even in this case a pit can be seen on either side of the urethral orifice indicating the embryological site of their external opening. Of sixteen specimens examined by us, in four the canals were present on both sides, in four no canal was present on the right side, in three no canal was present on the left, whilst in five the canals were absent on both sides. Hammond[3] states that a small amount of mucus-like secretion is produced by a few tubular glands which open into the canals, and that the canals are small in heifers which have never had a calf but that considerable hypertrophy occurs during pregnancy. Rœder (quoted by Hammond, *loc. cit.*) found that in old cows the canals frequently become much smaller. Several authors [2] [3] [4] have recorded occlusion of the openings of Gärtner's canals and their consequent distention with a clear fluid secretion, which gives the canals in some cases a tortuous cord-like appearance, or in others causes a series of small spherical swellings along the ventral aspect of the vagina. Williams[4] in one case found the duct greatly distended with innumerable calculi, some of which were 1 cm. in diameter; surgical interference in this case resulted in the development of a carcinoma at the site of the incision. Most authors are agreed that distention of Gärtner's canals are of no importance in the causation of sterility.

Circular or Annular Folds in the Bovine Vagina

The walls of the vagina are traversed by a series of longitudinal folds in the mucous coat which run forwards to terminate near the cervix.

One of the special, but in our observation constant, features to which we wish to draw attention, since they are not described in standard works on bovine anatomy, is the presence of annular or circular folds in the bovine vagina. They are situated in the walls of the anterior part of the vagina and form a series of complete rings round the organ. Usually four to six folds are present (see Figure 1). In normal animals the first fold is situated at a distance of some 9 to 11 inches from the vulval orifice (labia), and the succeeding rings are about ½ to 1 inch apart in the living animal. The last fold is approximately 1 inch from the outer lip of the cervix. In maiden heifers and primiparæ they do not appear to be so marked or as numerous as in older animals and in three such cases only two folds were observed. Examination of dissected specimens shows a thin circular band of smooth muscle immediately below the mucous coat corresponding to the site of each fold. These bands in preserved specimens were approximately ½-inch apart and were undoubtedly responsible for the "puckering" effect which is observed in the vaginal mucosa. In the live animal the muscular bands appear to have a marked power of constriction and in some of the cows examined they narrowed the lumen to such an extent as to confuse it with the cervix.

According to our observations, as we have already stated, the circular folds appear to be a constant feature of the vagina of the bovine. This finding is based on (a) a detailed examination of the dissected specimens of the genitalia obtained from three maiden heifers, four primiparæ and nine pluriparæ, and (b) a vulvo-vaginal examination of nine cows, all of which had had more than one calf and three of which were in-calf at the time of the examination. Most of the

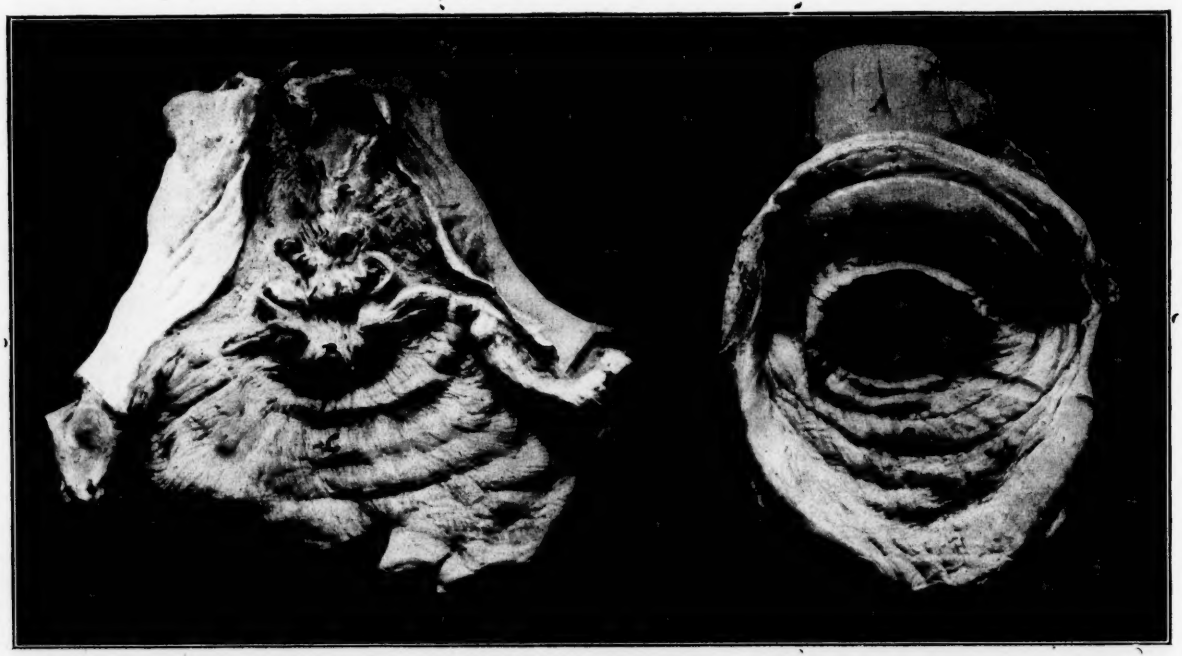

FIG. 1.—Formolised specimens of anterior vagina and cervix showing circular folds; specimen on left shows the cervical canal exposed. Note that the circular folds appear to be in series with the rougal of the cervical canal. A—body of uterus; B—labium of os uteri externum; C—anterior vagina.

standard works on bovine anatomy omit all reference to these folds, although Schmaltz[5] and Ellenberger and Baum[6] both show them in a diagram and name them " Faltenkränze " (circular folds) but make no mention of them in the text.

In a visual examination of the vagina with the aid of a speculum the possibility of confusing one of the circular folds with the *os uteri* should not be overlooked. Under certain conditions one of the circular folds may so constrict the lumen of the vagina that the constriction looks almost exactly like the *os uteri*. Confusion is likely to arise should a speculum which is some inches shorter than the length of the vulvo-vaginal tract be used. The usual over-all length of the Polansky speculum for use on adult cows is about 14 inches; in old, and especially in cows of the larger breeds, the length of the vulvo-vaginal tract is several inches larger than this. When the speculum is opened in such cases, the vagina may not dilate beyond the end of the speculum, and the constriction formed by one of the circular folds lying just beyond the extremity of the speculum may be mistaken for the cervix. This is likely to happen particularly in the pregnant cow where the vagina does not show the same tendency to balloon out as it does in the non-pregnant animal. If, however, the speculum is left *in situ* for one or two minutes it will be found that complete dilation of the vaginal lumen takes place and the cervix is exposed. Another possibility of error arises in cows where there is displacement of the *os uteri*, so that it comes to lie on the floor of the vagina; in such cases a cursory examination may lead one to mistake one of the circular folds, usually the penultimate, for the cervix. From a clinical point of view, therefore, we would emphasise the importance of differentiating a constricted circular fold from the *os uteri*. This should not present any undue difficulty to the *careful* observer.

The Occurrence of a Vertical Band of Tissue in the Vagina

During the artificial insemination of two maiden heifers a thick fleshy band of tissue was observed in the vagina of each of the animals when a speculum was inserted. In each case the band passed vertically across the *os uteri* to which it was closely applied. The bands appeared to be attached at their extremities to the roof and floor of the vagina. In actual fact they were attached to the extremities of the cervix. Each band was approximately 1 inch across at its middle and 1½ inches at its attachments. It was possible to insert two fingers between the band and the *os uteri*, but in neither case could the bands be broken by strong traction, and at this stage they were left intact. In order to insert the inseminating syringe into the *os uteri* it was necessary to push the band aside. In both animals the rest of the genitalia were normal.

Both heifers conceived as a result of the insemination. In the case of the first animal to calve it was noticed that considerable straining was taking place without the calf being expelled. Examination showed that whilst the calf's head was through the *os*, its further passage was being prevented by the band. At each labour contraction the calf's head and the band were pushed almost to the level of the vulval labia, but when the contractive movement ceased the band forced the calf's head back into the vagina. The band was therefore cut and successful parturition was immediately completed. In view of the difficulty encountered at parturition with the first of the heifers, the band was cut in the second animal

a few days before she was due to calve and in this case expulsion of the calf was effected without difficulty.

The vertical bands observed in the two cases conform very closely to the description given by Williams[4] of the persistence of the median wall of the Müllerian ducts at the vaginal end of the cervix. They appear to be identical with that shown in the figure on page 31 of Williams' book. According to this author the Müllerian ducts may be arrested at various stages in development, giving rise to greater or less abnormality in the genitalia. The form here described is less extreme than some of the other forms, e.g., uterus unicornis, double uterus, etc., and is met with in cattle with relatively greater frequency than in other species. Williams' contention that such abnormalities have a hereditary basis finds support in the fact that the subjects of this report were sired by the same bull out of unrelated dams. Other daughters subsequently got by this bull to the same two cows and to other cows in the herd have all been normal. Although the evidence is slight, it would appear to suggest that this abnormal character is transmitted as a recessive.

Summary

1. A short review of the gross anatomy of the vulvo-vaginal tract and its associated structures in the bovine is given, together with some original observations on the ducts of Bartholin's glands and on the canals of Gärtner.

2. In 16 dissected specimens of the bovine vulvo-vagina the length of the ducts of Bartholin's glands was found to vary between $\frac{3}{8}$ and $1\frac{3}{8}$ inches.

3. In the 16 dissected specimens, the canals of Gärtner were present on both sides in four cases; in four, no canal was present on the right side; in three, no canal was present on the left; whilst in five cases the canals were absent on both sides. The longest canal in our series was 8 inches.

4. Where the canals of Gärtner were completely absent, a pit on either side of the urethra indicated the embryological site of their external opening.

5. A description is given of a series of annular or circular folds in the anterior part of the vagina, which appear to be a normal feature in the bovine.

6. An account is given of the occurrence of an abnormal vertical band of tissue in the vagina of each of two heifers. This band would appear to be due to the persistence of the median wall of the Müllerian ducts at the vaginal end of the cervix.

7. Reference is made to the clinical importance of the features described.

Acknowledgment.—We are greatly indebted to Professor R. Rae for the facilities afforded in the examination of live animals in the Reading University herd.

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Clinical Article

A TREATMENT FOR MANGE IN HORSES

By H. LOMAS, M.R.C.V.S.

THIS recipe was designed to suit the conditions of a large stud in which it may be necessary to cater for a change of staff at any time. The routine of treatment should be simplified as far as possible to enable the work to be carried on efficiently.

Sinapis is the only ingredient which is unusual in mange treatment, the others being old and well-tried remedies.

The recipe is as follows:

Sinapis (Alb. et Nig.)	7 parts by weight
Sulph. Sublim.	5 parts by weight
Sulph. Nig.	3 parts by weight
P. Antim. Nig.	1 part by weight

Mix the powders well.

Treatment.—Clipping and singeing are the first essentials, and then one takes a measure of the powder to which is gradually added three similar measures of cold water. The usual way of applying it is to mix it up in a small pail with a soft swab and lightly cover the affected areas, but it must not be rubbed in.

In the case of a thin-skinned horse one uses four parts of water instead of three.

The reason for the inclusion of sinapis is the well-known fact that it causes a temporary paralysis of the sensory nerve endings, and as this condition seems to persist until some time the next day it was found to be helpful and beneficial in that after the first dressing there was no further desire to do any rubbing.

The routine of a case of psoroptic affection is to dress the parts affected and put the animal immediately on pillar-reins for about two hours. In all, four dressings are necessary, each every fourth day. On the morning after the dressing has been applied it will be found that the ingredients have become somewhat caked owing to the physical properties of the sinapis acting as a binding agent; it requires to be gently broken up by hand in order to bring the powder in proper contact with the skin. The parts are not washed until after the fourth dressing, i.e., the seventeenth day of the case, when it would be prepared for the inspector to sanction release.

In symbiotic cases, since the skin of the legs is so much thicker, rather more liberty can be taken with the dressing: it is a good plan to use a strength of three to one after the legs have had a good scrubbing with soft soap and water, and it will do no harm to repeat the application every third day. It is particularly useful when a horse is difficult to shoe from this cause if the horse is dressed one day and shod the next.

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Abstract

NUTRITIONAL DISEASES OF THE EQUINE*

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RESULTS of nutritional research in the past few years and their practical application are making us more and more conscious of the nutritional deficiencies from which man and domestic animals suffer. It is to be regretted that we have less factual knowledge concerning the nutritional requirements of horses than any other species of domestic animal. This is due partly to the high cost of conducting nutritional experiments with horses, to the gradual reduction in the horse and mule population, and to the fact that nutritional deficiencies have not been so obvious in farm horses as in other domestic animals. The extent of the problem is indicated by the evidence that many nutritional deficiencies of man and domestic animals are the result of a depletion or primary deficiency in the soils on which our foodstuffs are produced and it might well be added that so many horses and mules are not fed a hay and grain ration in quantity known from long years of experience to be required for normal health.

Minerals

The relation of calcium and phosphorus in the animal's ration and in its blood to those pathological formations of the osseous system such as ringbone, sidebone, spavin, and navicular disease, has received considerable attention. Many of the experiments, which have been conducted since 1907, have shown that a low calcium intake causes a general skeletal disease. The ratio of calcium to phosphorus in the feed has been found at fault more frequently than the actual amount of either mineral. A wide calcium-phosphorus ratio has been considered more harmful to horses than some other species of domestic animals.

In the United States, many of the recent observations on the calcium-phosphorus requirements of horses have been made on army animals. Greenlee[1] noted marked improvement in horses suffering from lamenesses after approximately one-third of the low-calcium native hay was replaced with alfafa hay.

To Kintner,[2] who analysed the reports of others and last reported his own work in 1940, it appeared that the quality, density, or strength of the bones of horses is based on their mineral or ash content, and that the mineral or ash content is influenced by the proportion of calcium to phosphorus in the animal's ration.

A wide calcium-phosphorus ratio has not always been found to produce skeletal alterations. Howell, Hart and Ittner[3] kept horses on a vitamin-A-deficient ration, with varying amounts of calcium and phosphorus, for more than a year. They found that marked individual alteration occurs in horses but concluded that a calcium-phosphorus ratio as wide as 1 : 7 was not a serious factor in preventing normal calcium-phosphorus utilisation and skeletal development.

The blood-serum calcium and phosphorus of horses vary but little from normal, even with quite wide variations in the intake of these minerals. In

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only a small percentage of cases can we detect faults in the amounts of calcium or phosphorus in the feed of horses, or pick out cases of lameness that are associated with abnormal amounts of calcium or phosphorus in the ratio as by blood analyses. Even with an unbalance in the calcium and phosphorus of the ration, these elements tend to stay within the normal range in the blood stream. Following abrupt changes in the amounts of these minerals in the ration, abnormal blood levels have been found.[4] The blood level then tends to return to normal on the same intake of calcium and phosphorus. The greatest danger appears to be in feeding an excess of either calcium or phosphorus, in which case the one in excess may cause a precipitation and consequent deficiency of the other element.

In acute skeletal diseases and in some special circumstances, both low serum calcium and inorganic phosphorus have been found.[4-6] Chronic cases of lameness due to skeletal defects are seldom associated with low levels of calcium or inorganic phosphorus in the blood serum.

As time goes on, no doubt, more accurate methods of measuring the effects of different levels of minerals and vitamins in the ration and in the body tissues will be developed. It should be remembered, however, that blood analyses are not always dependable in detecting calcium or phosphorus deficiencies of horses to the extent of their being the sole diagnostic evidence of disease. If the blood serum reveals a normal calcium and phosphorus, it does not necessarily mean that the animal's intake is absolutely correct, or that some of the tissues are not suffering from an unbalance of these elements. Normal variations often overlay findings reported on recognised, abnormal cases. In many instances our knowledge of the blood chemistry of normal and abnormal horses is to-day not such, in itself, as to enable an accurate, conclusive interpretation. Therefore, the clinician still has the responsibility of making the diagnosis and recommending the treatment.

As regards bone disease—examples, ringbone, spavins and sidebone—it might be well, in passing, to mention the fact that by many they have long been considered as hereditary. The U.S. Army Remount breeding stations, some State stallion registration boards, and many breeders disqualify such individuals.

Vitamins

Reports on the vitamin requirements give little information regarding the needs of horses. In California, Howell *et al.*[3] experimented with horses on a vitamin-A-deficient diet. It required over one year on this diet to produce a characteristic syndrome of night-blindness, followed by keratinisation of the cornea, respiratory symptoms, capricious appetite, weakness and death. Arthritis, with lameness, occurred in all cases. They considered that they did not have positive evidence that the joint involvement was primarily due to vitamin-A-deficiency. If the ration does not contain yellow corn, succulent pasture, or properly cured hay, it is apt to be deficient in vitamin A. There is some evidence that vitamin A acts as a sort of precursor of vitamin C, especially in those animals that synthesise their own vitamin C. Horses are in this class of animals. The vitamin-C content of the blood cannot be increased by feeding ascorbic acid. At the Kentucky Experiment Station we have four horses that have been on a

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vitamin-A-deficient diet for more than one year. Three of them produced foals the past spring. One foal died of pneumonia at 30 days of age. There is some possibility that this foal developed pneumonia through lack of vitamin A. One foal is very thin in flesh and small of bone, yet, in general, it appears healthy. The other foal has developed to fair size, considering the ration he and his dam have received. As all four of these animals were mares, they were bred last spring and three of them are now in foal. Only one has developed night-blindness after approximately one year on the vitamin-A-deficient diet. This animal has remained in excellent flesh throughout the year. None of them have shown symptoms of ill health, although one of them is now rather thin in flesh.

Vitamin C

There is, as you know, a chemical test for vitamin C. There have been some reports (Phillips *et al.*[7]) of good results in the treatment of bulls of low fertility with ascorbic acid. We have been unable to find any correlation between the ascorbic acid content of the semen or blood in stallions known to be so-called "shy-breeders." In each of three instances, in which we analysed the semen and blood from groups of stallions in a stud where there was a "shy-breeder," the ascorbic acid content of some of those of high fertility was high, while others in the same group were lower than the stallion of low fertility.

In our work on periodic ophthalmia, we have been examining the fluids of the eyes for vitamin C, and the spinal fluid of wobblers for vitamin C, in connection with our work on that disease.

From our work it is clear that the average, normal vitamin-C content of the aqueous fluid of the eyes is approximately 22 mg. per cent. In cases of periodic ophthalmia, the average vitamin-C content of the aqueous fluid was 9.19 mg. per cent. It is supposed to be responsible for some cases of cataracts in horses, the same as reported in man.

We feel that there is a possibility that the low vitamin-C content might explain the recurrence of ophthalmia, as vitamin C has directly to do with the permeability of blood vessels. The frequency of cataracts in periodic ophthalmia may be due to the low vitamin-C content of the eye fluids and the consequent upset in metabolism of the lens. This would further upset the physiological functioning or metabolism of the eye. Inasmuch as the vitamin-C content of the aqueous fluid apparently does not return to normal following an attack of periodic ophthalmia, the metabolism of the entire eye may suffer as a result. In some cases, where there is a change in the permeability of the blood vessels, as in purpura in the human, vitamin C has not effected cures, but vitamin P, or citrin, which occurs naturally with ascorbic acid in citrus fruits, has effected cures.

In examining the spinal fluid for vitamin-C content, nine normal horses gave an average of 2.22 mg. per cent. The average for eight wobblers was 1.19 mg. per cent. While the averages of the nine normal cases and the eight diseased animals are quite different, the spinal fluid of wobblers has not been consistently low in vitamin C. Some cases have been within what is considered the normal range. This is in agreement with findings in man. In medical literature, low vitamin C has been correlated with infection. From our work it would seem to be correlated with inflammation, but not necessarily with infection.

Intricate Relationships

Judging from information so far available, there is undoubtedly a very direct relation between minerals, vitamins, proteins and the endocrine glands and the more intricate metabolic processes of the animal body. The oldest known example is iodine and the thyroid gland. Thus, upon information which we now have, it is safe to conclude that in many of the clinically-apparent deficiency diseases of horses, a solution is not going to be brought about through the administration of any one particular element but rather that we are going to keep animals in a state of health through the use of natural foodstuffs of a quality and quantity that will furnish the animal all the essential nutritive elements from the food which he eats. At least that should be the basis upon which we proceed wherever possible.

It is recognised that there are areas in the United States where certain essential elements are lacking in the soil, hence they are lacking in the hays and grains grown on these soils. In all such cases, it may be the most practical and economical procedure to furnish the missing elements in pure, concentrated form. There is a large area in the North Central portion of the United States, where animals suffer from an iodine deficiency. In Florida, cobalt has been found to be one of the essential elements in which animals become deficient; also lime and phosphorus. In many other parts of the country—Texas, Michigan and Minnesota—the disease known as "pica" and "stump-sucking disease" is observed.

One of the first evidences of a nutritional disturbance in domestic animals is a depraved appetite. When horses gnaw the bark off trees, eat up board fences, such as we have in Kentucky, or chew the rails and fence posts in other parts of the country, it invariably means that the animals are not receiving a hay and grain ration that satisfies their every requirement from a nutritional standpoint.

I have always felt that horses that are heavily parasitised have a tendency to develop a depraved appetite. However, parasitism and malnutrition are so intimately associated that it is often difficult to tell where one leaves off and the other begins.

It is appreciated that essential factors, including minerals, vitamins, proteins and carbohydrates, may be deficient in the available foodstuffs in particular areas or that the best natural foods are not produced in these areas, and thus the only solution in such cases is to supply the factors lacking as a supplement to the foods that are available.

Adequate Natural Feeds

Nevertheless, as far as the animal industry of this country is concerned, the real and only satisfactory way to make sure that our domestic animals are properly and adequately nourished is to feed them on the natural foodstuffs grown on land that contains all the essential food elements required by plants and animals. From what I have been able to observe and from what I have learned from others, I cannot help but feel that large areas in the south-eastern portion of the United States will never do well in the production of horses and mules and will never do too well in the maintenance of mature horses and mules until they have better pastures and grow more feed.

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It seems to me that the most serious problem of nutrition of horses and mules in the greater portion of the South is the lack of feed, in both quantity and quality. A horse should have good mixed hay, 50 per cent. of which is clover or some other good legume. As a grain ration, horses should have yellow corn, oats and bran, with the addition of linseed oil meal, soybean meal, or even cottonseed meal, so that the supply of protein will be adequate. There are many roughages other than hay that may be used to a good advantage. Increased production of those that can be raised most economically and the purchase from other sections of what is needed to balance the ration would be my idea of a practical solution of the major nutritional disease problem met in equine practice.

Where horses are on fairly good pasture during the grazing season of the year, they will be fairly well fortified to go through the winter on a more or less inadequate ration. When the common mineral elements (calcium and phosphorus) are deficient in the good available, they can be supplied very economically. Other elements, such as iodine, iron, copper, cobalt, sulphur and manganese, are also relatively inexpensive. Certain of the vitamins are now available in pure concentrated form or in products fortified with them. Their cost to-day may be somewhat high in proportion to animal values; however, with new developments for their production in quantity they will become cheaper.

Correct Diagnosis Important

As veterinarians, we are duty-bound to render such assistance as the condition seems to warrant when we find animals that are sick and in a run-down condition because of some nutritional disturbance. Most of the minerals and vitamins that are known to be essential for animals are available for use in those cases where they seem to be indicated. However, interested as we are in the live stock industry of the country, we must not be satisfied to go on indefinitely and continuously, treating animals through the recommending of mineral supplements and the administration of vitamin concentrates and mixed bacterins when natural food will give better results. From the information gained in the years when autopsies were held on horses, it is well known how often horses harbour parasites in kinds and numbers as to cause one to wonder how the hosts could have remained alive as long as they did. One would dare say that horses and mules in the South are no exception to the rule.

In a case of ill health that appears to be of nutritional origin, our first duty is to make sure that the animal is as nearly free of parasites of the digestive tract as science and our personal ability enables us to make him. This will go a long way towards improving nutrition. Further, we should keep in touch with the results of those who are working on soil conservation and fertility and studying experimentally the nutritional requirements of animals. Those of you who are members of the Horse and Mule Association of America will know of the paper presented last year by Professor William A. Albrecht, of the Missouri Experiment Station, Columbia, Missouri, under the title, "Good Horses Require Good Soils"; also, the paper by Dr. F. B. Morrison, of Cornell University, "The New Developments in the Feeding and Nutrition of Horses and Mules."

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Treatment of Deficiencies

Horses on a hay-oat ration that are kept in a stable or dry lot when not in use, no doubt, suffer from a nutritional upset. This most often occurs in the lighter breeds of horses at army posts and in horses that are used for racing and show purposes. It is well known that many stallions that are kept in the stable frequently show symptoms of unthriftiness that are quite evident to the person in charge of the animals and to the veterinarian. While such animals may show a low calcium content of the blood, the clinical symptoms are quite as reliable evidence of the animal's condition as the results of the blood examination. Horses in training, especially runners and trotters, have been given injections of calcium gluconate, cal-dextrose, or straight glucose and have immediately shown improvement; however, such improvement is usually temporary.

To correct the condition requires the feeding of a ration that supplies all the essential nutritive elements. It may be advisable in some cases to give calcium and phosphorus as a supplement; however, more natural and lasting results will come from supplying vitamins D, A and the B complex from their natural sources. More recently vitamin C has come to be considered essential in general health as well as in certain specific conditions. There have been opportunities to make suggestions, particularly in regard to a number of young stallions, and in most instances the feeding of a variety of natural foodstuffs has brought about a material improvement. In some instances supplementary food elements may be advisable. We have recommended adding to the regular grain ration a small quantity of "baby chick starter mash." If this mash is purchased from a company that puts out a standard product of known vitamin content, you may be sure it will prove very beneficial.

We have had an opportunity to observe a good many colts and young horses being raised in central Kentucky and have conducted many blood examinations. On those farms where the weanlings and yearlings were out on good pasture and were being fed good mixed hay, yellow corn, and oats, the calcium-phosphorus level in the blood was found to be high and these elements in the proper proportion. This is mentioned to bring out the fact that, after all, where horses can have natural foodstuffs, they will not, as a rule, suffer from nutritional disease.

During the last ten years, many blood samples from horses have been examined for calcium and phosphorus. Eighteen weanlings on bluegrass pasture, clover-timothy hay, oats and yellow corn, examined in November, showed an average serum calcium of 13.12 and phosphorus, 4.62. Eight horses, all young except one, examined in July, showed an average calcium of 12.8 and phosphorus, 4.81. These animals were on pasture, clover-timothy hay and a mixed grain ration. All were in excellent physical condition. Such results show definitely that when horses are on good pasture, and are receiving grain and hay, the serum calcium and phosphorus have always been found to be at the normal maximum.

In a few instances we have found, for example, a group of weanlings that were on pasture and were being fed a liberal hay-grain ration, plus a supplementary feeding of calcium and fish oils, rich in vitamins. Six of some 20 colts showed clinical evidence of defective leg development. As the condition became worse, the natural tendency was to increase the supplement. However,

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our recommendation was to discontinue *all* supplements. Improvement was soon evident and in the end all of the colts were clinically normal.

We have had occasion to study a number of cases of abortion in mares that would appear to be of nutritional origin. There have been a number of foals dead at birth (full term) that, from all available evidence, were attributable to some nutritional disturbance. In most of these cases the mares had been fed on a submaintenance ration. In a few cases, the nutritional defect was apparently due to the lack of some one particular nutritional element.

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Abstracts of Current Literature

Diethylstilbestrol in the Treatment of Incontinence in Spayed Bitches and Other Conditions. By GERRY B. SCHNELLE, V.M.D., *Angell Memorial Animal Hospital, Boston, Mass. N.A.V.* Vol. 23. 1942. Pp. 447.

SCHNELLE records additional observations on the use of the drug in incontinent spayed bitches and other conditions. He reviews the effects in a series of nine cases and formulates the following conclusions:

(1) Diethylstilbestrol is effective in the control of urinary incontinence in spayed bitches.

(2) Dosage of 1 mg. daily for three days, followed by 1 mg. every third day, is effective in moderate-sized dogs such as Setters and Shepherds.

(3) Diethylstilbestrol gives promise in the relief of the symptoms of false pregnancy.

Determination of Œstrum in the Fox Vixen. By CHARLES F. BASSETT, M.S., and JAMES R. LEEKLEY, B.S., *Fur Experimental Station, Fish and Wild Life Service, U.S. Department of the Interior, Saratoga Springs, N.Y. N.A.V.* Vol. 23. 1942. 454-456.

INVESTIGATIONS to determine the period within the annual breeding cycle when conditions are optimum for impregnation. Vulvar measurements were taken and vaginal smears made on 65 fox vixens during the 1940 breeding

season. A close relationship exists between vulvar swelling and the percentage of cornified cells occurring in the vaginal smear. (Correlation + .57.) The peak of receptivity corresponds with the beginning of vulvar recession and the highest percentage of cornified cells.

Vulvar swellings of yearling vixens during the œstrus cycle is definitely less than for adults, although the percentage of cornified cells in the vaginal smears of these same yearlings is considerably higher.

The relationship between the vulvar swelling and the percentage of leucocytes present in vaginal smears is negative but very significant. (Correlation — .73.) The appearance of large numbers of leucocytes in vaginal smears taken at varying times following copulation is indicative that the vixen is no longer receptive and œstrum is over.

Receptivity is at or near its peak:

(1) When the percentage of leucocytes present in vaginal smears is very small.

(2) Immediately after the greatest vulvar swelling.

(3) At or near the period of greatest vaginal cornification.

These three phenomena taken together constitute the most reliable guide in determining the proper time at which to mate.

Coccidiosis of Poultry. By C. D. Lee, D.V.M., M.S., *Veterinary Research Institute, Iowa State College, Ames, Iowa. N.A.V.* Vol. 23. 1942. 458-460.

Coccidiosis in chickens is a major disease problem in commercial and farm poultry flocks in the U.S.A. The author deals with the cause, symptoms and lesions. The symptoms are not especially characteristic. It is a disease primarily of young chicks between four and twelve weeks old. The severity of the disease depends upon the numbers of coccidia ingested.

As to treatment, no remedy has proved of any great value.

Control is the major factor and this depends upon:

(1) Accurate diagnosis as soon as possible.

(2) Segregation of affected birds.

(3) Strict hygienic measures.

(4) Stimulating and nourishing food. (One cup of stock feeding molasses to 1 gallon of water or 30-40 per cent. buttermilk in the mash, fed for one or two days, are recommended to stimulate appetite and for the elimination of waste products.)

(5) As coccidiosis is a self-limited disease if strict hygienic measures are adopted, infection cannot take place.

These measures are applicable for turkeys.

Feeding as a Contributory Factor in the Development of Chronic Mastitis. By E. L. Moore, H. O. Henderson, A. H. van Landingham and C. E. Weakley. *Am. Jl. Vet. Res.* 1942. *III*, 154.

The author's summary is as follows: "A study was made of 26 animals to determine the effect of heavy corn feeding as a contributory factor in the development of mastitis, and 16 animals to determine the effect of rate of feeding the grain ration. No appreciable difference was noted in the incidence or severity of mastitis between the experimental and control lots. Physical, biologic and chemical tests demonstrated wide variation in the severity of mastitis among individuals, but not always between the two groups. No appreciable increase in the incidence or severity of mastitis was observed as a result of the kind of ration or the rate of grain feeding under the conditions of the experiments."

The Influence of Storage in the Chemical Composition of Nicotine Sulphate and Copper Sulphate Drench. By M. C. Franklin and R. F. Powning. *Aus. Vet. Jl.* 1942. *XVIII*, 72.

Experiments were carried out in which storage over a period of eight months of drenches containing approximately 2 and 12 per cent. of copper sulphate and nicotine sulphate was studied. The results showed that "such a mixture might be kept indefinitely, provided glass, earthenware or other suitable containers be used." It had been stated by Carlson (*Vet. Med.*, 1939, *34*, 48) that such a drench which had been prepared some time previously should be shaken frequently while being administered to sheep. The authors could not confirm the necessity of this action. They found that the sludge which forms in the mixture does not lower appreciably the concentration of the two ingredients, and that, therefore, it is not necessary to add a stabilising agent to the mixture. They found that "The presence of a colloid, such as gum arabic, prevents sludge formation, but the chemical data indicate that no improvement in retention of the active ingredients in solution results." It is interesting to note that the use of rain-water is recommended in the preparation of the mixture, for, as the authors say: "Some of the bore-waters in parts of Australia are highly mineralised and often contain a large quantity of alkaline carbonates which could precipitate some of the copper and so reduce the anthelmintic value of the drenches containing copper sulphate or other soluble copper salts."

A Filterable Virus from Pneumonia and Diarrhœa in Calves. By J. A. Baker. *Cornell Vet.* 1942. *XXXII*, 202.

The author found that "from pneumonia and diarrhœa of calves, a filterable agent was secured in mice that produced a condition similar to the natural disease. The transmission of the disease from calves inoculated intranasally with infected mouse lungs to normal calves by pen contact and the neutralisation of the virus in mouse tests by sera from calves recovered from the natural disease, further indicated that the virus came from calves. It is therefore concluded that an infectious pneumonia and diarrhœa of calves is caused by a filterable virus.

The Behaviour of Resazurin in Milk. By C. K. JOHNS. *Can. Jl. Res.* 1942. *20,* 336.

A CONSIDERABLE amount of attention has been given lately to the resazurin test for determining the hygienic quality of milk and its substitution for the methylene blue test. Reference in this article is made to a paper by *Thornton et al.,* in which it is stated that "a significant proportion of results cannot be interpreted with the reasonable certainty necessary to justify the widespread use of these (resazurin) tests by the dairy industry." Johns carried out a series of experiments and came to the conclusion that resazurin is equally as sensitive as methylene blue to the metabolic activities of bacteria in milk and that it is "decidedly more sensitive to the presence of non-bacterial factors in abnormal milks, e.g., mastitis, late lactation, etc., and therefore furnishes a more comprehensive index of the true quality of the milk."

The Effect of Phenothiazine-Salt Mixtures on the Development of Parasite Larvæ in the Fæces of Sheep. By R. T. HABERMANN and D. A. SHORB. *N. Amer. Vet.* 1942. *23,* 318.

FROM experiments carried out by the authors at the U.S. Department of Agriculture the authors came to the conclusion that phenothiazine-salt mixtures given daily to sheep in the proportion of 1 to 9 to 1 to 14 were effective in stopping the development of parasite larvæ in the fæces. The development of parasite larvæ in the fæces was arrested in 48 hours after the administration of 0.5 gm. or more of phenothiazine. During the summer months, when the salt consumption of sheep is greatest, it is possible that phenothiazine-salt mixtures of 1 to 9 to 1 to 14 concentration might be of value in controlling pasture contamination and thereby reduce the infection of animals grazing on pasture.

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